

# Technology Adoption and Agricultural Development in Sub-Saharan Africa (SSA): A Nigerian Case Study

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This study examines the impact of technology adoption on food security in Sub-Saharan Africa. Using Ukum rural community, Benue State, Nigeria, as case study site which significantly represents other Nigerian-SSA farming communities, the study tracks the impact of farmers' adoption or non-adoption of improved technology on food security vis-à-vis factors shaping their choices. It aims to make the case that adoption boosts productivity and improves food security among others. Fifty farmer-participants were randomly selected using participant observation, structured interviews, questionnaires and photographing for data collection. Applying descriptive statistics including frequencies, tables, charts and percentages, field data were analyzed. Study findings strongly suggest that the main factors significantly affecting adoption of technology include cultural values, institutionalized land tenures, cropland size, poverty, literacy level, technology complexity, agricultural extension services, age and sex. Results suggest significant correlation between literacy level, economic power and technology adoption: younger, more educated farmers with higher economic status tend to adopt new technologies; farmers with access to agricultural extension services and credit facilities were more inclined to adopting new technologies; women were found more disadvantaged in the male-centered, exclusionary land tenure practice. Consequently, the study recommends sustained public sector interventions aiming to reduce food insecurity in the region.

*Keywords:* technology, education, food security, culture

## Introduction

This study explores the impact of improved technology adoption on food security in SSA using a Nigerian agrarian community as case study. It is premised on the assumption that food production—like other human activities—takes place in often natural, social, political, economic, ecological, cultural, institutional, complex contexts which form a constellation of determinants shaping how it functions. Any attempts at understanding food insecurity in Nigeria in particular and SSA in general, the study hypothesizes, entails simultaneous understanding of the complex underpinnings impacting agricultural production in SSA. The need for this approach to the study of agricultural development in the region has become more urgent than ever given the fact that many factors persistently beset the region's agriculture sector resulting in significant recurrent shortage in food productivity. This situation has given many students of contemporary Africa the cause to entertain founded fears expressed in such conclusions as, "[...] in the present political and economic situation it is hard to see how the required agricultural transformation can be achieved" (Morgan & Solarz, 1994, p. 57).

In the fight against food insecurity, emphasis on inputs from the social sciences has not been strong enough. For, while academics transmit theories in classrooms, and agricultural scientists research for the best ways of doing agriculture to ensure food sufficiency, there is still the grave but often overlooked need to get into the practical field of farmers' experience to find out factors impacting food production: this is the distinguishing posture and contribution of this study. Ideologically, it positions itself as a three-way bridge between farmers, agricultural development theorists and researchers. As such, this study is a response to the critical situation of food crisis in SSA by engaging in the on-going multistranded dialogue on how to overcome the problem. The ultimate aim of the study is to use findings from the practical field of ethnography and replicable scientific generalizations therefrom to inform and provoke more relevant case studies to shape policies affecting the SSA agriculture sector.

### **Study Background**

The state of food insecurity has been a major concern for governments of SSA and has provoked interventions from different departments of the United Nations (UN) and Non-Governmental Organizations (NGOs). This concerted solicitude underscores the fact that everything about the human existence depends on good nutrition (UN-Food Summit, 1996) because "Food is integral to human wellbeing" (Foresight, 2011, p. 8). The problem has become even more urgent in our times as populations of SSA are continually ravaged by hunger and poverty. A combination of factors account for the situation and include but not limited to population growth outpacing food production per capita which has been in decline; increased food importation (Delgado & Mellor, 1984; World Bank, 2012); high incidence of hunger and poverty making SSA to be described as the world's poorest with 46.4% of its population living on less than \$1 a day (World Bank, 2005a, 2005b; Eicher, 1982); unpredictable and intractable drought (European Commission, 2016; Gilbert & Reynolds, 2008); absence of agricultural extension services; lack of access to credit facilities; lack of adequate, functioning infrastructure (UN, 2008, p. 1; Jouanjean, 2013, p. 3); corruption (Ake, 1996; Oyeshile, 2015); incessant intra-inter-ethnic conflicts (Morgan & Solarz, 1994; Richardson & Sen, 1996; Achodo, 2000; Arias & Ibanez, 2013; Kimenyi et al., 2014); and very importantly low level of improved technology adoption.

The overall result of this conspiracy of drawbacks is heightened poverty especially in rural areas for which USAID (1997, p. 8) declares the region the "[...] ultra poor of the world" with 45 to 50 percent of SSA's 726 million people living below the UN international poverty line of US \$1 a day. If poverty is more prevalent in rural SSA, it is more so because over 70 percent of its population is rural most of whom depends mainly on agriculture, produce about 90 percent of the region's food need (Morgan & Solarz, 1994; USAID, 1997; Ake, 1996), accounts for about 40 percent of its Gross Domestic Product (GDP), 30 percent of exports, and 75 percent of employment (Ake, 1996, p. 45). Ironically these rural populations are continually neglected by the public sector. Top among the ways they experience this neglect is the deprivation of capital assistance and related farm inputs to help farmers adopt improved technologies to boost productivity.

It is against the foregoing background that this study was undertaken aiming to understand how farmers of SSA are impacted by low or non-adoption of improved agricultural technologies, why they are slow in doing so, and to search for ways to overcome the problem. Doing this has become more urgent than ever since SSA has been very backward in reducing poverty and fighting hunger in particular and in meeting the Millennium Development Goals (MDGs) in general (UN-Millennium Project, 2005, 2007) as is thus surmised:

A review made by the World Bank, to find out to what extent progress has been made on reaching the above mentioned goals, suggests that most countries of [SSA] are off track on most of the targets and will need to increase the rate of progress. (SESRTCIC,<sup>1</sup> 2007, p. 5)

### Study Methodology

The study operates on the theoretical framework that, all things being equal, adoption of improved agricultural technology portends to boosting productivity; reduces poverty and hunger; ensures food security and agricultural sustainability; makes farmers more competitive in the global market; helps improve farmers' social capital to contribute more to their nations' GDP among others. It further works on the postulate that people naturally adjust to situations of more food demand by seeking better ways to maximize their production potential even within limited cropland resources (Hunter & Whitten, 1976, p. 231; Flannery, 1969, p. 57). One of the ways of making this situational adjustment is the application of more efficient technologies otherwise the *mechanization* of agriculture comprising technological innovations and interventions including but not limited to tractor machines; research; crop and animal seedlings hybridization; facilities including fertilizers, fungicides, herbicides and pesticides; knowledge dissemination machinery through agricultural extension services; soft credit pockets; on-off-farm storage facilities; processing plants; water resources management especially irrigation; and the role of state policy apparatus, institutions and infrastructure. All these are "[...]crucial for farmers to achieve optimum profitability from their businesses and to attain an acceptable quality of life for themselves and their families" (Houmy, Clarke, Ashburner, & Kienzel, 2013, p. iii). As its overarching motif the study joins in arguing that, "One important way to improve agricultural productivity is through the introduction of improved agricultural technologies and management systems" (Doss, 2014, p. 3).

To operationalize this theoretical framework the study applied relevant social science data gathering techniques including extensive interviews, questionnaires, photographing, and most importantly participant observation. Descriptive statistics including frequencies, tables, charts and percentages were employed in data analysis. Five questions guided the study: What is the relationship between improved technology adoption and increased productivity? How does non-adoption of improved technology impact farmers? What factors determine adoption/non-adoption choices? How can problems associated with non- or low adoption of improved technologies in SSA be overcome? What role/s does cultural factors play in all this?

The study followed the model of political economy especially in its emphasis on understanding factors shaping humans' efforts to eke out a living from their environment. It was chosen for its take on a socially grounded etymology whereby a definitional stance starts with social practices, not fully formed concepts since meaning of ideas is forged in concrete social practices. Political economy partly informed this study since it is itself the science of wealth dealing with man's efforts to supply wants and satisfy needs (Eatwell et al., 1987, p. 109) and so serves as the intellectual description for a system of production, distribution, and exchange having originally meant the social custom, practice, and knowledge about how to manage, first, the household, and later, the wider community. Its main focus is to understand factors impacting this economic process and so "[...] encompasses studies of production, circulation, accumulation and consumption of goods, services, and value" (Preucel & Hodder, 2004, p. 99).

Fifty farmer-participants were randomly selected from the site; the maps (Figures 1 and 2) show where the study occurred.

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<sup>1</sup> SESRTCIC is an acronym for Statistical, Economic, and Social Research and Training Centre for Islamic Countries.



Figure 1. Map of Nigeria with its 36 States.

Note. Key:  Indicates study site.



Figure 2. Map of Benue State showing Study Site.

Ukum was selected for this study because it typifies what is common among many Nigerian-SSA farming communities. With its population of 216,983 occupying a land mass of 1,810.99 square kilometers, Ukum has a gently undulating topography with tropical sub-humid climate split into dry and wet seasons with a total annual rainfall of 1,200 to 1,500mm. It has a natural vegetation comprising grasses, shrubs and trees and gives good quality timber for carving, firewood and furniture. Ukum is surrounded by tributaries of the Benue River<sup>2</sup>. These and other features dispose Ukum for the cultivation of many crops including yam, groundnuts, cassava, sweet potatoes, rice beans, maize, millet, guinea corn, soybean, tomatoes, peppers, and citrus of all kinds. These crops especially yam and groundnuts are produced in commercial quantities explaining also how Ukum has been drawn into full market economy especially after its contact with British colonialization in the 1910s (Down, 1933; Bohannon, 1953). It is on account of Ukum's outstanding performance in food production that Bohannon (1968) and Gbenda (2012) noted that agriculture is its main economic activity. It is also the reason this study chose Ukum as its research nich to experiment on the already defined theoretical framework guiding it.

## Representation and Analyses of Field Data

### Farming Systems Practiced in Ukum-Nigeria

Ukum farmers practice a combination of crop and animal husbandary with the former being more prevalent while the latter is minimal. The choice of farmers in this regard is driven by economic factors, weather conditions, value systems, and personal choice. Ukum farmers prefer crop farming because it gives them more food and money to afford other commodities. They grow more of yam and groundnuts because, in addition to being the crops most favored by their soil conditions, they also have ready and more competitive market and serve both subsistence and export ends.

### Animal Farming Among Ukum-Nigerian Farmers

Ukum-Nigerian farmers practice animal farming almost always on free range (Figures A1 and A2 in

<sup>2</sup> The Benue River, previously known as the Chadda River or Tchadda, is the major tributary of the Niger River, which itself is the third largest river in Africa, and forms a confluence with the Benue River at the town of Lokoja in present-day Kogi State, Nigeria. The Benue River is approximately 1,400 kilometers long and is almost entirely navigable during the summer months.

Appendix A). While this is convenient and a source of income, the practice is however less desirable for some reasons: few people rear them; many do not practice it because not much income accrues from it; many of the animals wander off or are stolen; they are destructive of crops and vegetables; and their droppings that otherwise constitute rich source of organic manure are lost because they are randomly dropped. Many who keep these animals, especially sheep and goats, do so for social prestige. Chickens are more domesticated especially by women who also sell them at the weekly local markets. When these *casual* animal farmers are compared with their counterparts who control sizeable poultry and piggy farms, we see how this type of animal farming diminishes the chances of reducing food insecurity and poverty. For, unlike them, the latter enjoy the benefits of easy-to-harness organic manure from their in-house animal farming in addition to higher income and regular, better protein-rich nutrition.

### Crop Farming Among Ukum-Nigerian Farmers

As shown in Table 1, Ukum farmers as with majority of Nigerian farmers cultivate a wide range of crops (Oluwasanmi, 1996; Bohannan, 1968; Forde, 1964). They practice intercropping (interplanting) and sequential cropping. In intercropping, one major crop, usually yam, occupies the farm land and a host of minor crops and vegetables are planted on heap sides (Bohannan, 1953; Ford, 1964; Ibeawuchi, 2007). These sidecrops include maize, peppers, okra, spinach, pumpkin among others. Intercropping is claimed to provide farmers with early and sometimes year-round sustenance especially during the months they await the maturation of yam. On the other hand, in sequential farming, one major crop is followed by another after the former is harvested. In Ukum, yam is followed by groundnuts (Table 1).

Ukum-Nigerian farmers work very hard and generate tons of food stuffs brought into and out of their many local markets. While Figures A3 and A4 (Appendix A) serve only as few examples of the quantity of food stuffs that come into Ukum markets on daily basis, Figure A5 (Appendix A) represents how large quantities of agro produce leave Ukumland daily. They all bespeak what obtains in other farming communities of Nigeria in particular and SSA in general.

Table 1

*Types of Farming and Kinds of Crops and Animals Grown by Ukum-Nigerian Farmers*

MIXED FARMING IN NIGERIA									
Animal Husbandry					Crop Farming				
*Done by Free Range					*Done On Plots of Croplands				
1. Goats					<b>Intercropping:</b>	Usually yam is the major crop and followed by a mixture of other crops and vegetable including but			
2. Pigs						not limited to pumpkins, okra, spinach, peppers,			
3. Sheep						tomatoes, melon, and maize. When yam is harvested,			
4. Fowls						other crops with longer life span such as cassava are left.			
5. Cattle									
<b>Comment</b>									
Not all farming households keep these animals for several reasons especially because they are destructive of crops, difficult to manage, and are not as economically rewarding as food crops.					<b>Sequential Cropping:</b>	Usually yam is followed by groundnuts. With the			
Except in Northern Nigeria where cattle is reared in great numbers, other parts of Nigeria do little or no cattle keeping because of tse-tse fly infestation.						harvest of yams over, the same mounds from which yam tubers are removed are converted into ridges for			
						the planting of groundnuts rushed within three			
						months, usually April/May through to July inclusive, in			
						order to take advantage of the rains before they slack.			

### Tools and Implements Currently Used by Ukum, Other Nigerian and SSA Farmers

Ukum-Nigerian farmers employ an array of manually operated tools for agricultural production. These include big and small hoes, cutlasses, axe, hammer, harvesting stick, pickaxe, fertilizer peg, wheel barrow, basins, sickle, “go-to-hell” and sprayer. All stages of crop production are manually carried out as shown in Figure B1 and B2 (Appendix B). The tools are fabricated by indigenous blacksmiths as is exemplified in Figures B3, B4, B5, and B6 (Appendix B) with the advantage that it makes them more readily available and affordable for farmers. Appraised in light of the region’s food insufficiency, however, the critical point sets in to show how the use of these *old* hand tools enhances the problem at hand: farmers invest more time, labor and capital but earn far less commensurate output especially in the face of continually growing populations and shrinking cropland size.

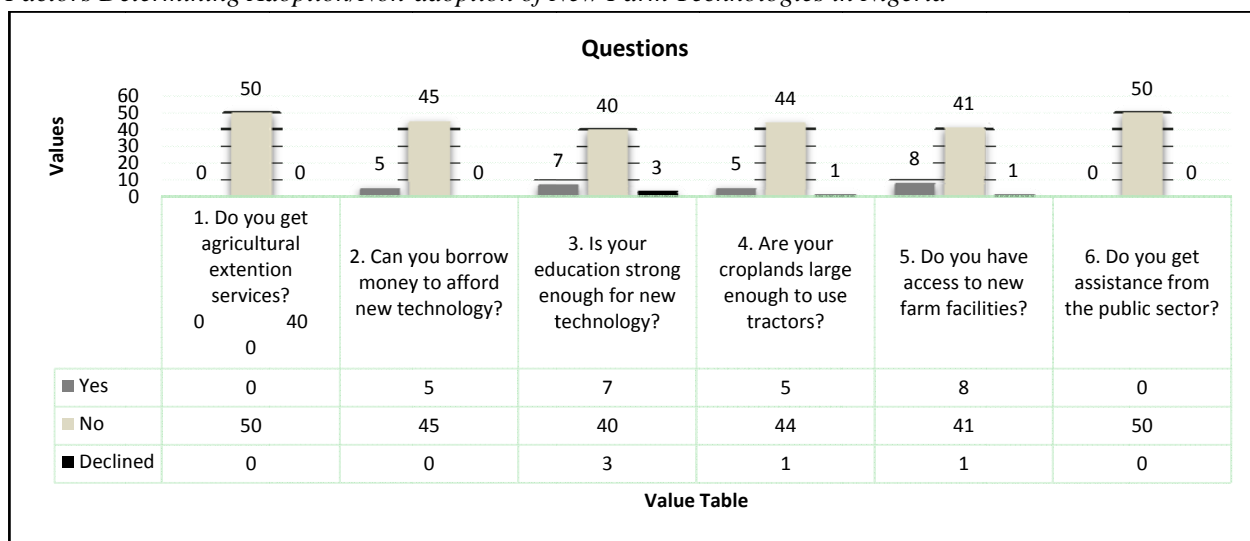
### Factors Determining Adoption or Non-adoption of Improved Technology and Its Effects

Table 2 shows that all 50 respondents declined getting agricultural extension services (AES). Further pressed, they stated they never saw any AES agents in their community. Worse still, 45/50 respondents indicated being unable to borrow money from micro finance institutions to facilitate entry into the use of new technologies since they cannot personally afford required capital. Whereas 40/50 participants stated that they do not have the level of education to understand and manage new farm technologies, 41/50 gave lack of access to new innovations of farming technology as an inhibition to adoption. Very strikingly important, 44 out of 50 stated that if, and when, they are open to adoption their farmlands are not large enough to promote the use of such farm technologies as tractors more so because individual arable croplands are so scattered to be harnessed into large units.

Furthermore, population increase (and its attendant pressure on land), our study participants reported, act together with Ukum traditional land tenure to form a constellation of forces to reduce the size of croplands at farmers’ disposal; the same factors kill farmers’ investment incentives. Table 2 sums up Ukum-Nigerian farmers’ reasons for being slow to adopt new farm technologies.

Table 2

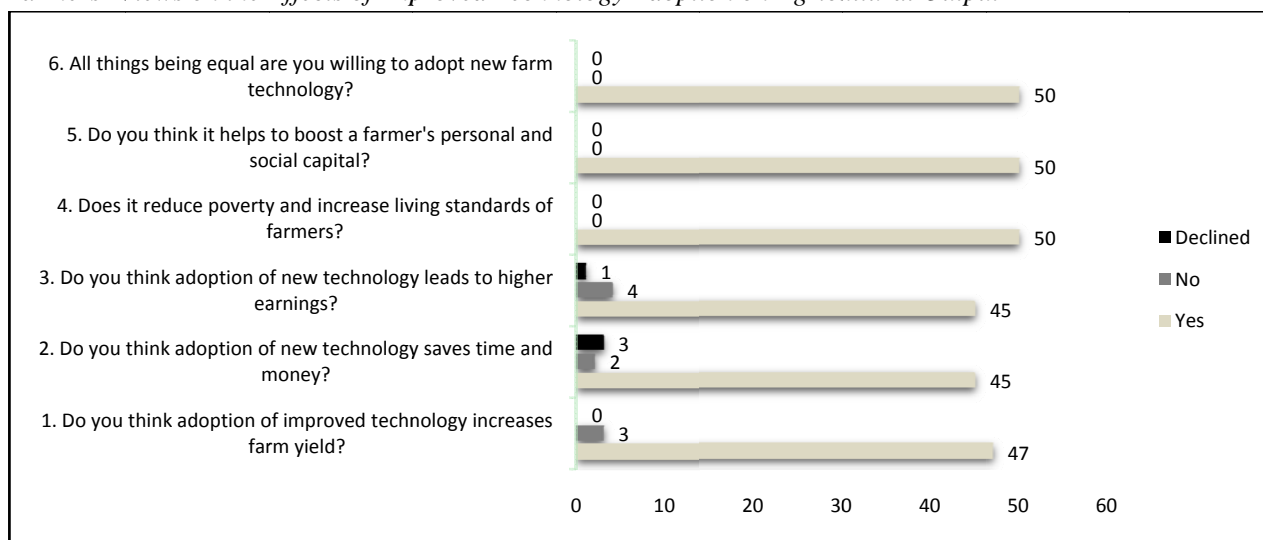
*Factors Determining Adoption/Non-adoption of New Farm Technologies in Nigeria*



Turning to farmers' perception of the impacts of improved farming technologies adoption (see Table 3), respondents overwhelmingly 47/50 indicated they know it leads to increased output. Similarly, greater majority (45/50) agreed being aware that adoption saves time and money investment. Whereas 45/50 agreed it leads to higher earnings, all 50 participants agreed it reduces poverty and raises farmers' living conditions and that it portends to boosting farmers' personal and social capital. It is not surprising, then, that all 50 participants said they are willing to adopt new technologies other things being equal.

Table 3

*Farmers' Views on the Effects of Improved Technology Adoption on Agricultural Output*



### Discussions: Appraising Our Study Findings in Light of Related Studies.

This study found that Ukum as with other Nigerian farmers spend many hours on land clearing, hoeing, weeding and other stages involved in food production without commensurate output for this huge investment in time, labor and capital. This discouraging drudgery is partly the result of the use of tools and the application of unimproved farming techniques far less responsive to the food crisis of SSA. In line with this finding, scientific studies such as those conducted by Mkandawire and Matlosa (1993, p.69) demonstrate that non-adoption accounts for why majority of SSA populations are at high risk of food insecurity and hardly able to feed themselves. Muhoho (1989) strongly corroborates our finding stating that there is a big gap between what SSA rural farmers realize from their farm input and what is potentially feasible with the application of mechanized technology.

Results from our direct observation strongly suggest that intercropping does more harm than good to farmers. In this we differ with Ibeawuchi (2007) who argues that it

[...] suppresses weeds, reduces pest disease infestation, gives yield advantage and there is stable yield over time. Intercropping encourages high nutrient uptake than in sole cropping and water use efficiency is high because of intercooperative interaction between the intercrops. It encourages high soil fertility maintenance especially where legumes are used as component crops they provide continuous soil cover, which prevents direct impact of raindrops, which causes erosion. (p. 46)

In addition to the foregoing pro-intercropping argument advanced by Ibeawuchi (2007), Akobundu (1987), Kurt (1984), Moody (1977), Hart (1975), Reminson (1978), Nangju (1980) also provide further support claiming it gives a high total of return per unit area of land, and that it is consistent with farmers' goal of food security.

Whereas there is some merit to the argument favoring intercropping in tropical Africa, we contend that such conclusions over-simplify and romanticize the practice. Intercropping, this study found, leads to soil nutrient depletion and environmental degradation occasioned, above all, by excessive competition among intercrops—very serious hard facts these studies easily gloss over. Worse still, African farmers, typified in our study participants, lack the funds to afford sufficient fertilizer to help the natural fertility of the soil to support the heavy load of many intercrops imposed on croplands especially with the competition for nutrients this practice engenders. The pro-intercropping argument obviously loses sight of the fact that even rural African farmers themselves are aware of its disadvantages for which they evolved regulations on the number of crops that could be intercropped to avoid poor output. As Forde (1964) documents,

After the yam planting [...] they plant between and on the side of the yam hills the minor crops of maize, coco-yams, okra, pumpkins, and beans [...] On the other hand the people<sup>3</sup> are aware that hills overcrowded with minor plantings are likely to yield poorly in yams and *fairly strict limits are set to this interculture* (emphasis ours). (p. 23)

While widespread among Nigerian-SSA farmers, intercropping is practiced more in areas with high population density resulting in the continual fall of cropland size leading to subjection of the same parcels of land to continuous cultivation with minimal fallow periods and minimal or no application of fertilizers to boost soil nutrients and crop productivity. Unfortunately, this aspect hardly features in the accounts overtly favoring intercropping; similarly, such studies fall drastically short of seeing how intercropping contributes to food insecurity.

Contrary to farmers' reason that sequential cropping helps to maximize the use of croplands, our evidence-based assessment, however, is that it leads to poor yield, soil quality depletion, and environmental degradation. The crop yield is even poorer when the follow-up crop is caught up in the dry season. The poor yield of groundnuts of our study participants within the periods of this study (2014 and 2015) validate our case.

From our findings we further argue that the disposition to adopt improved farming technologies is deeply behavioral: farmers' decision to adopt or not is influenced by many things including economic, social, institutional factors as Akudugu et al. (2012, p. 6) also found. Similarly, Adesina and Baidu-Forson (1995, p. 1) confirm our finding when they document that "[...] farmers' perceptions of technology characteristics significantly affect their adoption decisions".

Informed by our research findings and further enlightened by related studies, we argue that, continual use of unimproved farming techniques and tools very significantly affects output; it partly accounts for why SSA farming households lag behind in agricultural production; it places them at high risk of food insecurity; it makes them unable to improve their socioeconomics. Rehashed in a positive tone, our instructive argument strongly aligns with Houmy et al. (2013):

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<sup>3</sup> By the "people" as is used here Forde (1964) was referring to the community of Umor village in Yako in the present-day Cross River State Southeast Nigeria where he conducted the studies monographed in the publication *Yako Studies*. In his words, "The Yako of Middle Cross River area of Obubra Division live in five compact villages a few miles apart" (p. 1). "My main objective was the investigation of the economic life of a community of hoe cultivators in the West African forest zone, and I was concerned with the relations of this economy to both physical environment and social organization" (p. 1).



Farm production can be substantially increased through the use of mechanical technologies which are both labour saving and directly increase yields and production. Inputs of hard labour by farmers and their families can be substantially reduced if they have access to a carefully selected tools, machines, and equipment. The labour released can be used for other productive activities. The use of improved mechanical technologies can also have a direct impact on yields and area under production. (Houmy et al., 2013, p. iii)

The foregoing goes to confirm our study ideological posture and motif—that adopting improved agricultural technologies affects the rate of increase in agricultural output and determines how the increase in agro output affects poverty levels and environmental degradation even as also found by Meinzen-Dick (2002) and Muzari, Gatsi, and Muvhunzi (2012).

On the Nigerian scene specifically, this model has been employed as a springboard of research in many varied ways. For example, Awotide et al. (2013) assessed the determinants of intensity of improved rice varieties adoption and market participation among rural Nigerian farmers. The study found that farmers' adoption or non-adoption and market participation or non-participation are influenced by gender of household head, age of household head, wealth status, distance to source and cost of seed, household size, contact with extension agents, membership of organizations, access to seed, total of farmland, education background, and off-farm income. Similarly, Nwachukwu and Onuegbu (2007) tracked the impact of the degree of adoption of improved farming technologies on the level of productivity in aquaculture farming in Imo State, Southeastern Nigeria. They found that the level of adoption of new technologies among fish farmers was low: less than half of participants adopted the technology. However, looking beyond the impact of adoption or non-adoption, and tracking the role of other variables, Nwachukwu and Onuegbu (2007), Perkin and Rehman (1994) concluded that people do not just adopt a technology because it is available to them; even when it is available and appropriate, personal and socio-cultural factors bear on decisions to adopt or not to. Focusing on Lagos-Nigerian fish farmers' disposition to adopting new technologies, Ogunremi and Oladele (2012) found that among many who declined adoption, lack of fund (99.1%), technology application effect (60.0%), and skill/manpower (59.0%) constituted prime inhibitions.

Awotide et al. (2012, 2013) focused on sustainable rice productivity and rural farmers' welfare in Nigeria. Like others they found that adopting improved technologies increases productivity and significantly generates improvement in Nigerian farmers' living standards. However, they also found that lack of access to seed and poverty incidence were highest among factors dissuading non-adopters. Okereke (2012) applied the same model to explore the challenges of risk management among smallholder farmers in Ebonyi State, Southeastern Nigeria and found that adoption of improved agricultural technologies enhances productivity: it is one of the strategies farmers employed in managing risks associated with agricultural production with the regrets that lack of access to improved farming technologies (95%), high cost of improved technologies (93%), lack of access to weather information (91%), and lack of finance (82%) are the major problems constraining their ability to cope with the challenges of risk management. It is noteworthy that some six decades before the present era of food crisis in SSA Oluwasanmi (1996) had noted:

[...] the most serious limitations to efficient production in agriculture are the nature of farming implements, the state of agricultural knowledge, the quality of the facilities available for the dissemination of existing knowledge and the general nature of the social and institutional framework within which the agricultural industry functions. These factors are inevitably reflected in the volume of agricultural output both for domestic consumption and for export, and the output per unit of resources employed in agriculture. (p. 109)

Across other SSA regions many studies demonstrate that failure to adopt modern agricultural production technologies to a large extent explains why farmers produce less than is desirable and therefore experience high levels of poverty. Many studies also illustrate that non-adoption is in turn determined by some major factors including lack of access to facilities and poverty among others (Awotide et al., 2012). The study of the United States Agency for International Development (USAID, 1977, pp. 1-2) strongly aligns with our study in identifying factors constraining adoption of improved agricultural technology as cultural values typified, for example, in patterns of land size holding; lack of technically trained labor for high-yielding technology; complexity of new technologies; unavailability of required capital; lack of adequate product and factor markets; incongruity between recommended technologies and actual farmer conditions; and inadequacy of research on the economics of technology adoption. Similarly, targeting the impact of agricultural technology adoption on food security under climate change in Niger in West Africa, the UN Food and Agriculture Organization (FAO, 2015), found that, “[...] on average, the use of modern inputs has a positive and statistically significant impact on crop productivity” (p. 25).

Adesina and Baidu-Forson’s (1995) comparative study assessed the effect of farmers’ subjective perceptions of agricultural technology characteristics on adoption decisions using improved varieties of sorghum in Burkina Faso and improved varieties of mangrove rice in Guinea—both in West Africa. They found not only that the use of improved crop varieties enhances productivity but also that consumers critically evaluate characteristics of a product before adoption, and that demand (of improved varieties) is affected by consumers’ subjective assessments of product attributes. Other related studies such as Jones (1989), Lin and Milon (1993), Adesina and Zinnah (1993) carried out under this model but operationalized at different sites also ended in similar findings and conclusions.

Furthermore, tracking the influence of agricultural production techniques adoption on food security in Burundi, Ahishakiye (2011), Norton, Alwang, and Masters (2010), Beddington (2010), Jama and Pizarro (2008), and Jayne et al. (2003) concluded that, while African nation-states responded to the situation of food crisis in the region by pursuing different policies and strategies aimed at stimulating the adoption of new technologies and ultimately to boost food production and reduce poverty and hunger, this move has borne far less than expected results in Burundi as in other parts of SSA. This is because, they argue, SSA farmers are backward in adopting improved farming technologies with the result that they operate at levels of production far less than their potentials. Ahishakiye (2011) and Akudugu et al. (2012) found that farm size, expected benefits from adoption, access to credit and extension services are the factors that significantly influence technology adoption decisions of Ghanaian farming households.

### **Conclusions: Food Security Vision for SSA**

Based on our research findings further enlightened and corroborated by results from related studies—on the relatedness of food insecurity reduction and improved technology adoption in SSA—we can validly surmise that slowness to adopt new farming technologies significantly though partly account for why the region is still unable to effectively and sustainably end hunger and poverty as prime targets of the MDGs. On the other hand, some factors converge to ditch farmers of this region in food insecurity as have earlier been identified. To reduce, if not overcome, food insecurity completely, certain steps are imperative, which this study envisions in the following recommendations:

(1) SSA governments should step up with pro-poor capital allocation to the provision of new farm technologies, since it is far beyond majority of SSA farmers. This has been profitably done in other global regions typified, for example, in the Asian Green Revolution, and resulting among others in “[...] a dramatic impact on incomes and food supplies [...]” (Pinstrup-Andersen & Hazell, 1987, p. 1). Other researchers also affirm this; among them are Hazell (2009); Rosegrant and Hazell (2000); Hazell and Haddad (2001); Lipton and Longhurst (1989); Thirtle et al. (2003); Ravallion and Datt (1996); and Fan et al. (2000). This policy push is premised on the fact that, “[...] no Asian country developed its food staple agriculture from subsistence to market orientation without public intervention [...]” (Diao et al., 2007, p. 18).

(2) To realize the above vision, funding for on-going interdisciplinary, collaborative research must be prioritized by policy makers since “[...] massive public investments in modern scientific research for agriculture [...]” (IFPRI, 2002, p. 1) is a key component for sustainable agricultural development.

(3) Agricultural Extension Services (AES) should be made readily available and organized on small farmer-clusters since this is a guaranteed way to bring new innovations to farmers and farmers’ experiences to researchers.

(4) The public sector should create and encourage agricultural production among farmers through the establishment of institutions and regulations to guarantee availability of sufficient cropland; conflict-free environment; farmers’ cooperatives; and adequate, functioning infrastructure.

It is our strong conviction that only when these and related steps are taken could the dream to overcome food insecurity in SSA become a reality. When these steps are taken, the results will be glaring: food sufficiency; sustainable agriculture; improved living standards; economic and social transformation—because the democracy of doing agriculture will have left the arm-chair of political rhetoric and reposed in the hands of farmers themselves. This scientific belief, nay evidence-based conviction, is rooted in the fact that for SSA, “[...] agriculture must be the engine for economic and social progress” (USAID, 1997, p. v) bearing in mind that, “No country has been able to sustain a rapid transition out of poverty without raising productivity in its agricultural sector [...]” (Timmer, 2005, p. 1).

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Appendix A



Figure A1. Free Range Pig at Zaki-Biam Market.



Figure A2. A horde of sheep on free range grazing.



Figure A3. Groundnut bags head to Ukum market.



Figure A4. Yam heaps at Zaki-Biam Ukum market.



Figure A5. A truckload of yams leaving Zaki-Biam Ukum market heading other parts of Nigeria.



## Appendix B



*Figure B1. Land clearing by hand-pulling.*



*Figure B2. Making Mounds Using Hand Hoe.*



*Figure B3. Two young blacksmith apprentices.*



*Figure B4. A blacksmith at Zaki-Biam Market.*



*Figure B5. Hoe blades ready for sale.*



*Figure B6. Weeding hoes and wonden handles.*